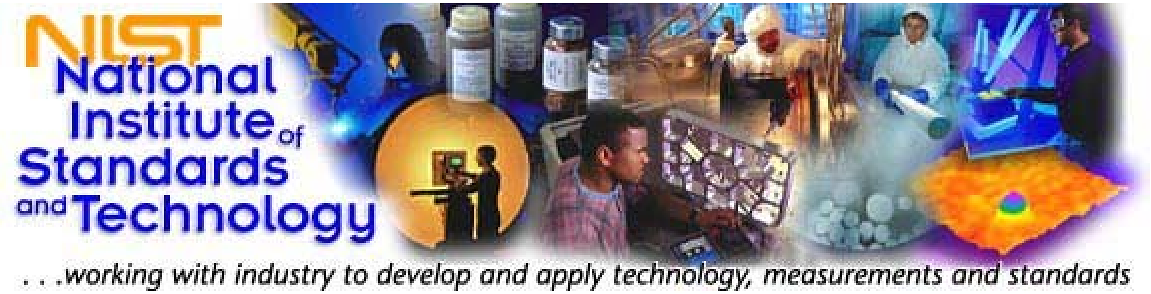


The Role of Economic Analysis at NIST

Gary Anderson
Economist, Program Office

Overview

- NIST’s role in innovation
- Economics & strategic planning
- Demonstrating impact
- Moving forward

NIST's Role in Innovation

NIST Mission

To promote U.S. innovation and industrial competitiveness by advancing

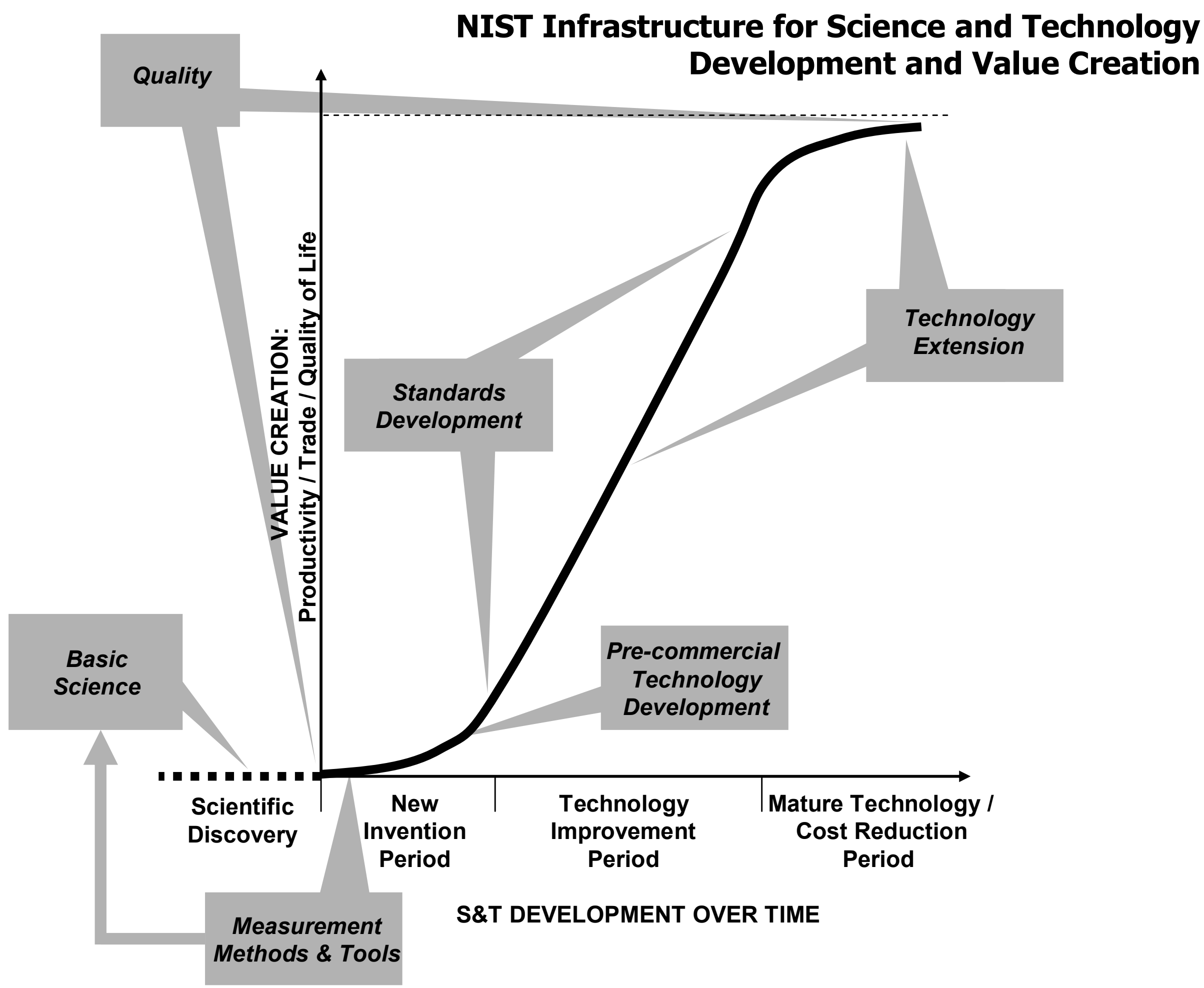
measurement science, **standards**, and **technology**

in ways that enhance economic

security and improve the quality of life for all Americans.

NIST's Role in Innovation

Infratechnology impacts every stage of innovation



NIST’s Role in Innovation

Industry’s Historic Role

•“The central economic fact about the process of invention and research is that they are devoted to the production of <u>information</u>.”

•The creation of new scientific and technological <u>information</u> is subject to non-standard economic problems and requires non-standard solutions.

•Large corporations must “self-insure” against scientific risk by funding a wide array of disparate research projects.

Kenneth Arrow - Nobel Laureate, “Economic Welfare and the Allocation of Resources for Invention,” 1962

NIST’s Role in Innovation

NIST’s Increasing Importance

How has the world changed since 1962?

- The scientific component of products has increased
  - Science is as technically challenging and risky as ever
- The national and global innovation environment has changed radically
  - The U.S. economy is more open
  - International competition is more intense and more technology dependent

NIST’s Role in Innovation

NIST’s Increasing Importance

The “ability of U.S. technology corporations to sustain funding of basic research not linked to core corporate activities has been eroded.”

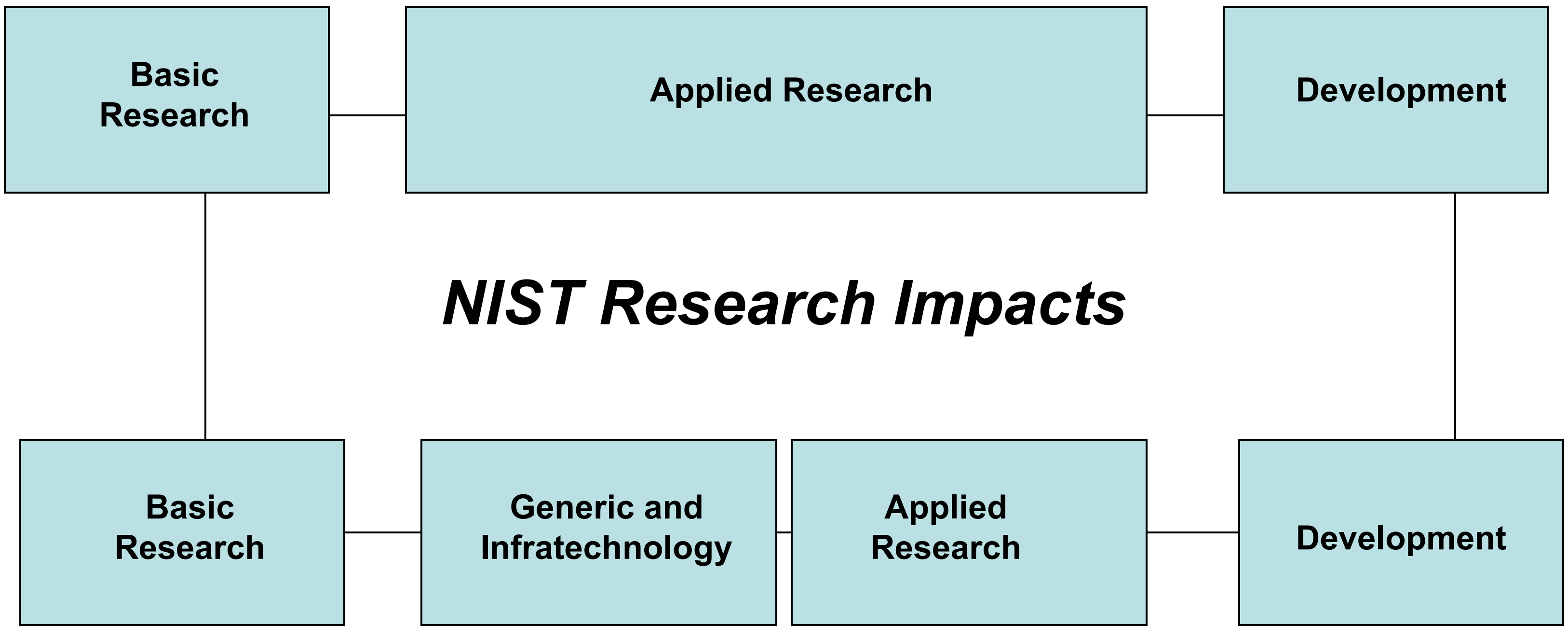
Auerswald and Branscomb, “Reflections on Mansfield, Technological Complexity and the ‘Golden Age’ of US Corporate R&D,” 2005

- Deregulation of domestic industry
- Global recovery post-WW II

NIST’s Role in Innovation

NIST’s Increasing Importance

National Science Foundation Classification



Tassey (1997)

Economics & Strategic Planning

Metrics for Success

"Scientists do, of course, make judgments all the time about promising lines of research…It makes sense for the world's largest sponsor of research, the U.S. government, to want to make such choices as wisely as the most productive scientists do…**But is it possible to decide rationally when to enhance or to terminate a project if we do not possess a way of measuring its success.**"

John Marburger, President's Science Advisor,
2002 AAAS Colloquium on S&T Policy

Economics & Strategic Planning

The Cost of Not Having Critical Infratechnologies

Focus of Study	Infrastructure Studied	Industries Covered	Estimated Annual Costs of Inadequate Infrastructure
Interoperability costs (1999)	• Product design data exchange	• Automotive supply chain	$1 billion
Deregulation (2000)	• Metering • Systems monitoring/control	• Electric utilities	$3.1–$6.5 billion
Software testing (2002)	• All stages of the testing cycle	• Transportation equipment • Financial services • Extrapolation to entire U.S.	$1.8 billion $3.3 billion $60 billion
Interoperability costs (2004)	• Business data exchange: production scheduling, inventory management, procurement, and distribution/marketing	• Automotive supply chain • Electronics supply chain	$5 billon $3.9 billion
Interoperability costs (2004)	• Business data exchange: design & engineering, construction, and operations & maintenance	• Construction/building systems management	$15.8 billion
Medical testing (2004)	• Quality of measurement assurance	• Laboratories (calcium)	$0.06–$0.199 billion

Demonstrating NIST Impact

Economic Studies Performed

- •Average benefit-cost ratio of 44:1 in 19 studies since 1996
- •Estimates of <u>direct</u> impacts only; no multiplier effect estimated
- •Caveat – selection of projects based on perceived existence of industry impact; not randomly selected
- •Topics cover wide range of technologies and industries and can be collectively viewed as a legitimate indicator of NIST industry impact

Demonstrating NIST Impact

Sample of Retrospective Economic Impact Studies: Outputs and Outcomes of NIST Laboratory Research			
Industry/Project	**Output**	**Outcomes**	**Measure**
Chemicals: Standards for sulfur in fossil fuels (2000)	• Measurement methods • Reference materials	• Increase R&D Efficiency • Increase productivity • Reduce transaction costs	IRR: 1,056% BCR: 113 NPV: $409M
Semiconductors: Josephson volt standard (2001)	• Measurement methods • Reference materials	• Increase R&D efficiency • Enable new markets	IRR: 877% BCR: 5 NPV: $42M
Communications: Data encryption standard (2001)	• Standard (DES) • Conformance test methods	• Accelerate new markets • Increase R&D efficiency	IRR: 270% BCR: 58–145 NPV: $345M–$1.2B
Communications: Role-based access control (2001)	• Generic technology • Reference models	• Enable new markets • Increase R&D efficiency	IRR: 29–44% BCR: 43–99 NPV: $59–138M
Energy: Gas mixture standard for regulatory compliance (2002)	• Standard (NTRM)	• Increase productivity • Reduce transaction costs	IRR: 221–228% BCR: 21–27 NPV: $49–63M
Manufacturing: Product design data standard (2002)	• Standard (STEP) • Conformance test methods/facilities	• Increase R&D efficiency • Reduce transaction costs	IRR: 32% BCR: 8 NPV: $180M

IRR=Internal (Social) Rate of Return, BCR=Benefit-Cost Ratio and NPV=Net Present Value.

Studies available at http://www.nist.gov/public_affairs/budget.htm

Demonstrating NIST Impact

Lessons Learned

1) Supply chains matter – bring supply chains together as part of the NIST infratechnology development program

- Produce infratechnologies with maximum impact
- NIST research meets need of all tiers of supply chain
- Improve measured and actual economic impact

2) Infratechnology needs/impacts of this-generation technology are critical

- Implementing infratechnology across large sector delivers significant impact
- There is scientific risk and innovation in measurement needs of established industries

3) Managing the transition to next-generation technology requires careful analysis and portfolio management

Demonstrating NIST Impact

Lesson 1: Supply Chains Matter

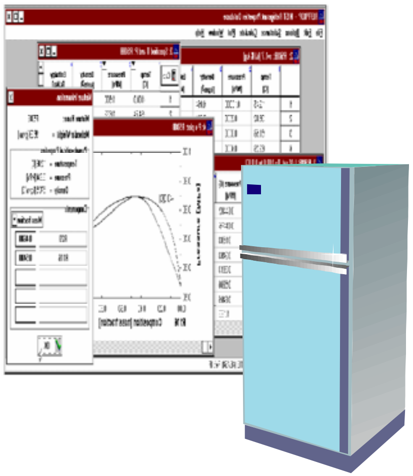
1995: Electric power and energy calibrations
41:1 benefit-to-cost ratio

1997: Thermocouple Calibration Program
3:1 benefit-to-cost ratio

Demonstrating NIST Impact

Lesson 2: Infratechnology Needs/impacts of This-Generation Technology

2000: Standard Reference Materials for Sulfur in Fossil Fuels
113:1 benefit-to-cost ratio



1998: NIST Alternative Refrigerants Research Program
4:1 benefit-to-cost ratio

Demonstrating NIST Impact

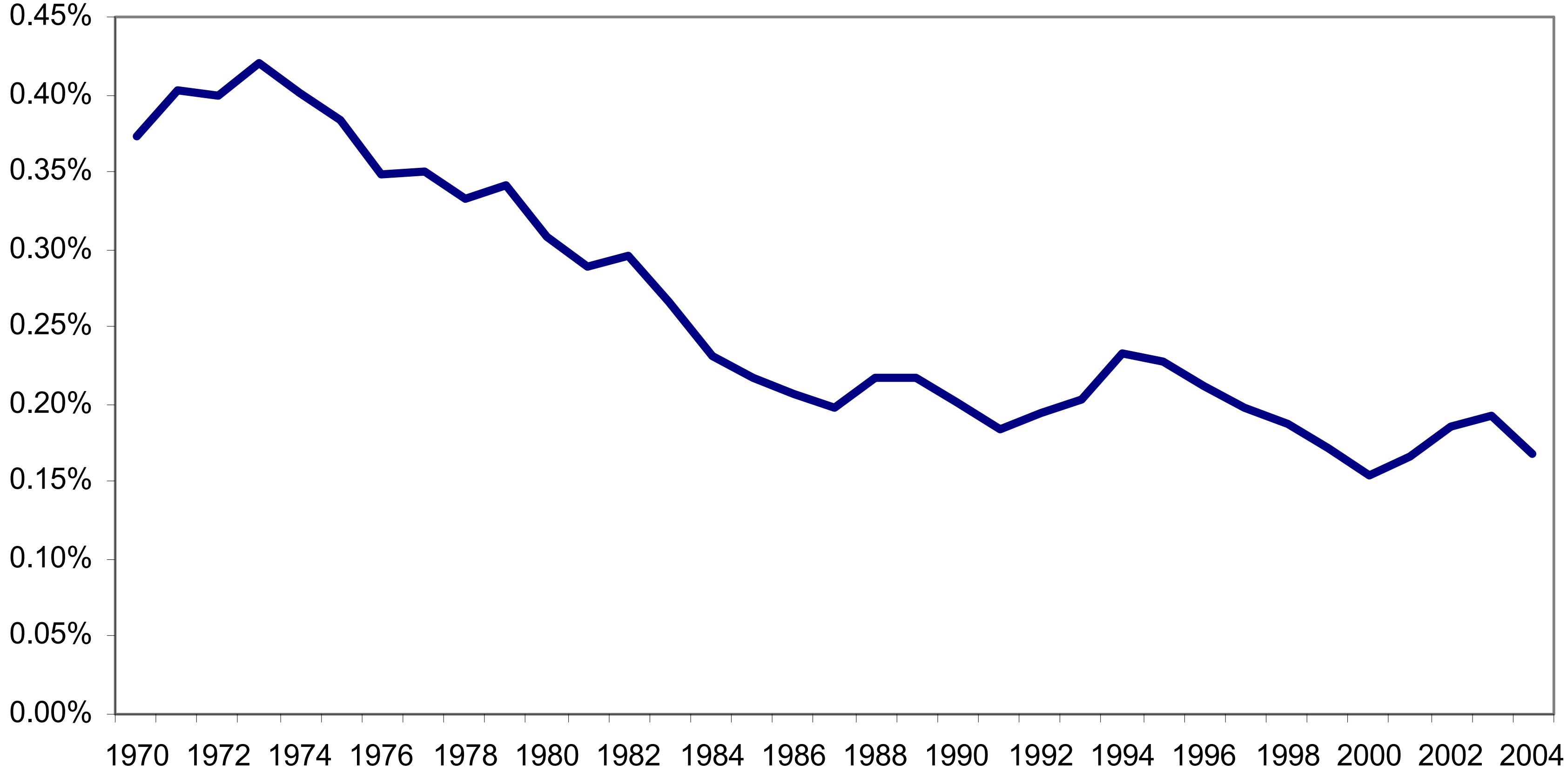
Lesson 3: Managing the Transition to Next-Generation Technology

2000: NIST Cholesterol Standards Program
5:1 benefit-to-cost ratio

Moving Forward

Increased Importance of Effective Budget Allocation

Ratio of NIST STRS to Industry-Funded R&D:1970-2004



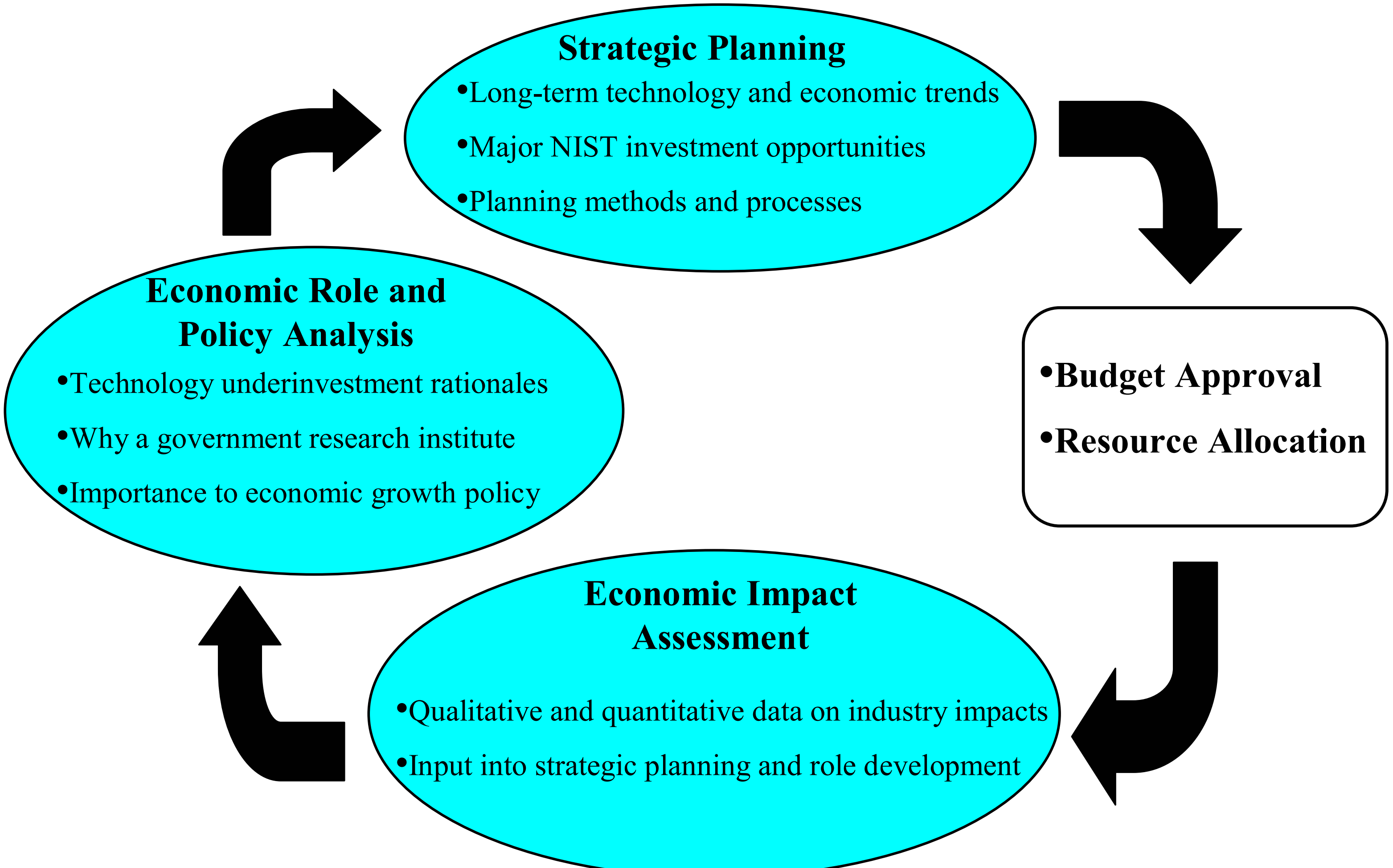
Moving Forward

Planned Analysis

- Programmatic Studies
  - Currently in process
- More microeconomic project studies
  - Planning studies
  - Impact studies
- Other types of prospective and retrospective analysis
  - Quality-adjusted performance metrics
  - Statistical analysis of NIST-generated patents
  - Econometric studies based on linked firm-level data

Moving Forward

Planned Integration



Moving Forward

Strong connection to national needs

+

Clear rationale for NIST's unique role

+

Demonstrated impact on economic security

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Results for NIST and the Nation